

**Claims:**

1. A radio frequency (RF) propagation device comprising:

a waveguide for propagating electromagnetic radiation, the waveguide having a longitudinal axis;

a first substrate mounted within the waveguide and positioned transverse to the longitudinal axis thereof, the first substrate being substantially transmissive of the electromagnetic radiation and having a first probe formed thereon for transmitting the electromagnetic radiation;

a second substrate mounted within the waveguide and positioned transverse to the longitudinal axis thereof, the second substrate being substantially transmissive of the electromagnetic radiation and having a probe formed thereon for receiving the electromagnetic radiation.

2. The device of claim 1 wherein the electromagnetic radiation comprises a first polarized signal and a second polarized signal and the apparatus further comprises a grid substrate mounted within the waveguide and positioned transverse to the longitudinal axis thereof between the first and second substrates, the grid substrate having a multiplicity of metallic lines disposed in a spaced apart relation and oriented to be reflective of the first polarized signal and transmissive of the second polarized signal.

3. The device of claim 1 further comprising at least one additional substrate mounted within the waveguide and positioned transverse to the longitudinal axis thereof, the at least one additional substrate being substantially transmissive of the electromagnetic radiation and having a probe formed thereon for receiving the electromagnetic radiation.

4. The device of claim 1 wherein the waveguide further comprises:

a first dog-channel proximate the first substrate for providing an output for the first probe; and

a second dog-channel proximate the second substrate for providing an output for the respective probe formed thereon.

5. The device of claim 1 wherein the first probe and the second probe have a length approximately two-thirds of the wavelength of the electromagnetic radiation.

6. The device of claim 1 wherein at least one of the first and second substrates comprise a material selected from the group of quartz, plastic, and glass.

7. The device of claim 1 wherein at least one of the first and second substrates is mounted within the waveguide via a groove, lip, or ridge formed within an interior surface of the waveguide.

8. The device of claim 1 wherein at least one of the first and second substrates is mounted within the waveguide via bonding compounds.

9. An radio frequency (RF) propagation device comprising:

a waveguide having a longitudinal axis and a first port for receiving electromagnetic radiation comprising a first polarized signal and a second polarized signal;

a first substrate mounted within the waveguide and positioned transverse to the longitudinal axis thereof, the first substrate being substantially transmissive of the electromagnetic radiation and having a first probe formed thereon, the first probe being oriented on the first substrate to transmit or receive the first polarized signal;

a second substrate mounted within the waveguide and positioned transverse to the longitudinal axis thereof, the second substrate being substantially transmissive of the electromagnetic radiation and having a second probe formed thereon, the second probe being oriented on the second substrate to transmit or receive the second polarized signal; and

a grid substrate mounted within the waveguide and positioned transverse to the longitudinal axis thereof between the first and second substrates, the grid substrate having a multiplicity of metallic lines disposed in a spaced apart relation and oriented to be reflective of the first polarized signal and transmissive of the

second polarized signal.

10. The device of claim 9 wherein the waveguide further comprises:

a first dog-channel proximate the first substrate for providing an output for the first probe; and

a second dog-channel proximate the second substrate for providing an output for the second probe.

11. The device of claim 9 wherein the first probe and the second probe have a length approximately two-thirds of the wavelength of the first and second polarized signals.

12. The device of claim 9 wherein the grid substrate is disposed one-quarter to one-sixth of the wavelength of the first and second polarized signals from the first substrate.

13. The device of claim 9 wherein at least one of the first, second, and grid substrates comprise a material selected from the group of quartz, plastic, and glass.

14. The device of claim 9 wherein at least one of the first, second, and grid substrates is mounted within the waveguide via a groove, lip, or ridge formed within an interior surface of the waveguide.

15. The device of claim 9 wherein at least one of the first, second, and grid substrates is mounted within the waveguide via bonding compounds.

16. The device of claim 9 wherein the grid substrate includes ten metallic lines per wavelength of the first and second polarized signals.

17. An apparatus for interconnecting a plurality of planar circuits comprising:

a waveguide for propagating electromagnetic radiation, the waveguide having a longitudinal axis;

a first substrate mounted within the waveguide and positioned transverse to the longitudinal axis thereof, the first substrate being substantially transmissive of the electromagnetic radiation and having a first probe formed thereon for transmitting the

electromagnetic radiation;

at least one additional substrate mounted within the waveguide and positioned transverse to the longitudinal axis thereof, the at least one additional substrate being substantially transmissive of the electromagnetic radiation and having a probe formed thereon for receiving the electromagnetic radiation.

18. The apparatus of claim 17 wherein the waveguide further comprises:

a first dog-channel proximate the first substrate for providing an output for the first probe; and

at least one additional dog-channel proximate a respective at least one additional substrate for providing an output for the respective probe formed thereon.

19. The apparatus of claim 17 wherein the first probe and the at least one additional probe have a length approximately two-thirds of the wavelength of the electromagnetic radiation.

20. The apparatus of claim 17 wherein at least one of the first and additional substrates is mounted within the waveguide via a groove, lip, or ridge formed within an interior surface of the waveguide.